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San Juan River Fish Tissue Contaminant Study
FY 2019-2020 Preliminary Planning Outline

prepared for Navajo Nation Environmental Protection Agency

The Navajo Nation Environmental Protection Agency (NNEPA) and Tetra Tech (Tt) will conduct a fish tissue contaminant study in the San Juan River for the Navajo Nation during FY 2020. The focus will be on monitoring current contaminant levels in fish, assessing prevailing human health risk associated with fish consumption, and building upon (and adding to) the knowledge gained from the 2017 San Juan River Fish Tissue Contaminant Study (NNEPA 2017). Whereas the 2017 study focused on metals only and on two reaches of the San Juan River (i.e., an upstream reach in New Mexico and a downstream reach in Utah), the FY 2020 study will include additional contaminants of concern and will expand spatial coverage (i.e., including the San Juan River from Navajo Dam in New Mexico to Lake Powell in Utah). This preliminary planning outline summarizes a phased approach for the study, with design/planning, mobilization, implementation, analysis, and reporting phases.

Phase 1 -- Design and Planning

NNEPA and Tt will work together to refine the study design in FY 2019 and plan for study commencement in FY 2020. Interaction and coordination with local state agencies (i.e., NM and UT), federal agencies (e.g., U.S. Fish and Wildlife Service), and the Navajo Nation Department of Fish and Wildlife (NNDFW) and confirmation of their participation will be crucial to ensure successful design/planning and implementation phases considering the large area proposed for study.

Important aspects to be finalized in this phase include:

- study reach accessibility and sampling logistics,
- schedules and timing,
- target species selection and availability, and
- target analytes.

Study reach accessibility and sampling logistics -- Current plans call for **collecting fish from six San Juan River study reaches**, covering an approximate total of 516 river kilometers (approximately 321 river miles):

1) from Navajo Dam in NM to the to the Animas River confluence,
2) from the Animas River confluence to Fruitland, NM,
3) from Fruitland to the Mancos River confluence, NM,
4) from the Mancos River confluence to the waterfall near Mexican Hat, UT,
5) from the waterfall to Lake Powell, UT, and
6) from Lake Powell proper.

Discussions with NNDFW and local state/federal agencies should focus on access in those six reaches, potential opportunities to coordinate fish collection activities with existing monitoring

programs and sampling events, and temporal advice (i.e., optimal timing from ecological, meteorological, river flow, and safety perspectives). Scheduling should account for preferred water temperatures and flows for sampling efficiency, focus on a time when the target species are most frequently harvested by anglers, consider when weather conditions are conducive to safe and efficient field sampling, and avoid the spawning season of federally endangered and state protected Razorback Suckers (*Xyrauchen texanus*).

Schedules and timing -- The field index period defined for the 2017 San Juan River Fish Tissue Contaminant Study was March to mid-May in an effort to precede elevated spring flows, and actual sampling was conducted during the first week of April 2017. Gido and Propst published a peer-reviewed paper in *Transactions of the American Fisheries Society* during 2012 entitled "Long-term dynamics of native and nonnative fishes in the San Juan River, New Mexico and Utah, under a partially managed flow regime." In that paper, the authors state that "Native fishes in the San Juan River generally reproduce during elevated spring flows" and "For most nonnative species in the San Juan River, reproduction occurs during the summer low-flow period." They conducted all of their San Juan River fish surveys between mid-September and mid-October citing that it was "a period when flows are relatively stable" in the San Juan. Considering the sampling period for the 2017 study and the Gido and Propst (2012) San Juan River-specific information on fish spawning in the area (during elevated spring and low-flow summer periods) and the potential for stable flows in late summer/early fall, **the proposed index period for the FY 2020 study is March to mid-May (i.e., prior to elevated spring flows) and/or mid-September to mid-October (i.e., during stable river flows).** Specific sampling dates will be contingent upon coordination of fish collection activities with NNDFW and local state/federal agencies and their existing monitoring programs and sampling events.

Target species selection and availability -- Following USEPA's *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume I: Fish Sampling and Analysis, Third Edition* (USEPA 2000a), the FY 2020 study teams will select fish that are commonly consumed by humans in the study area, and that may potentially accumulate high concentrations of chemicals (e.g., bottom dwelling species due to their potential for close contact with river bottom sediments). The teams will also consider species that are easy to identify, abundant, easy to capture, and large enough to provide adequate tissue for analysis. Given these criteria and site-specific recreational fishery information from NNEPA, NNDFW, and USFWS, the primary target species for the 2017 San Juan River Fish Tissue Study was Channel Catfish (*Ictalurus punctatus*). The FY 2020 plan proposes to expand the target species list to include trout and sucker species, if available.

EPA's *Analysis of the Biological Data Collected from the Animas and San Juan Rivers Following the Gold King Mine Release* Report (USEPA 2018) summarizes contemporary studies of metals in San Juan River fish including 2015/16 data for the New Mexico portion of the Animas and San Juan rivers collected by the New Mexico Department of Game and Fish (NMDGF). The report states that multiple fish species were present through the surveyed length of the rivers, although not all species were available at all sites. The only species captured consistently at all San Juan River sites was the Flannelmouth Sucker (*Catostomus latipinnis*). The NMDGF collected Bluehead Suckers (*Catostomus discobolus*), Brown Trout (*Salmo trutta*), Rainbow Trout (*Oncorhynchus mykiss*), Channel Catfish, and White Sucker (*Catostomus*

commersonii) as well, but they were not available in all study reaches. Based on this information, it appears unlikely that any single fish species will be available from the entire 516 river kilometer study reach. **Proposed target fish species for the FY 2020 are Channel Catfish, sucker, and trout species, with a goal of collecting two to three species from each of the six study reaches.** Sampling success in the study area will depend on river conditions at the time of collection and on the diversity/abundance of fish in each study reach.

The number of samples analyzed for contaminants will ultimately depend upon fiscal resources available for the FY 2020 study, but **the current proposal is to attempt to collect *at least* three fish composites (i.e., of two or three species, if available, and five fish in each composite) from each of the six sampling reaches** (following the recommendations and methods in EPA's Fish Consumption Advisory Guidance documents), focusing on fishes that are commonly consumed by humans. The total number of samples will be resolved during the FY 2019 Design and Planning Phase.

Target analytes -- The fish fillet tissue samples collected during the 2017 San Juan River Fish Tissue Contaminant Study (NNEPA 2017) were analyzed for a suite of 25 metals, mirroring those studied by EPA during their initial work after the Gold King Mine spill. Human health thresholds (i.e., screening values) were used to identify fish tissue concentrations above a level protective of human health. EPA risk-based fish consumption limits (EPA 2000b) were available for three of those metals, i.e., arsenic, cadmium, and selenium. The screening value applied for mercury was the EPA fish tissue criterion for methylmercury (USEPA 2006). All fish fillet results from the 2017 study were below the mercury criterion. Arsenic, cadmium, and selenium concentrations were all below method reporting limits; however, the analytical methods did not enable detection down to levels that allowed consideration of all consumption categories. Because of that, it was not possible to make fish consumption recommendations based on those chemicals without new (more sensitive) analytical methods and further data collection. The FY 2020 fish tissue study should include (at a minimum) arsenic, cadmium, mercury, and selenium analysis, and should consider emerging (although more costly) analytical methods for metals such as Inductively Coupled Plasma Mass Spectrometry (ICP/MS) with a hydride generation system to increase sensitivity (i.e., for arsenic, cadmium, and selenium).

In addition to target metals, the FY 2020 study will consider other contaminants of concern (COCs) that are persistent, bioaccumulative, and toxic, are known to be widely distributed in the environment, and/or have been recently recognized as COCs. Additionally, the list of analytes should include chemicals that have comparative human health criteria to evaluate the human health risks associated with fish consumption. Contemporary national probabilistic fish tissue studies (USEPA 2009) have demonstrated that (in addition to mercury) polychlorinated biphenyls (PCBs), dioxins/furans, and selected organochlorine pesticides (i.e., DDT and chlordane) are commonly detected in fish fillets, and in some cases at levels above human health protection thresholds (particularly mercury and PCBs). In addition, per- and polyfluoroalkyl substances (PFAS) have recently received scientific and regulatory attention due to their broad environmental distribution, persistence, bioaccumulative potential, and toxicity. Studies suggest that fish consumption may be a source of human exposure to perfluorooctane sulfonate (PFOS) or other long-chain PFAS (Stahl et al. 2014). The list of FY 2020 target analytes should also consider known fish consumption advisories in New Mexico and Utah, where advisories exist for

arsenic (UT), mercury (NM and UT), selenium (UT), PCBs (NM and UT), and DDT (NM). The final list of target analytes will ultimately depend upon fiscal resources available for the FY 2020 study, but **the current proposal is to consider analyzing the fish fillet composite samples for (at a minimum) arsenic, cadmium, mercury, selenium, PCBs (all 209 congeners), DDT, and PFAS.** The target analyte list and will be resolved during the FY 2019 Design and Planning Phase.

There is interest in looking beyond fish tissue contaminants and their associated human health risks and considering other tools, e.g., biomarkers, to diagnose the potential effects of endocrine-disrupting chemicals (EDCs) and other contaminants of emerging concern (CECs) on fish. In field studies, biomarkers of exposure such as vitellogenin (VTG) induction in male fish are powerful tools for tracking single chemicals and mixtures of concern. In field and laboratory studies, VTG in particular has proven to be a valuable biomarker for estrogens and antiestrogens in both adult and juvenile fish. The FY 2019 Design/Planning Phase will include discussion, consideration, and selection of appropriate biomarkers that are relevant and within the boundaries of available fiscal resources (however, the analysis of the fish tissue contaminants mentioned above will take budgetary priority). Selected biomarkers should be ones that are mechanistically relevant and analytically reproducible. VTG is a good example, in that it provides insight into the mode of action (estrogenicity) that is vital to fish reproductive health, and interlaboratory reproducibility has been documented. The final list of target biomarkers will ultimately depend upon fiscal resources available for the FY 2020 study, but **the current proposal is to include VTG (at a minimum).** The list of biomarkers will be resolved during the FY 2019 Design and Planning Phase.

Estimated Phase 1 cost: $32,000

Phase 2 -- Mobilization

Mobilization tasks include all activities that must be completed prior to the FY 2020 San Juan River fish tissue sampling event:

- Finalize the study design.
- Communicate and coordinate with NNEPA, NNDFW, and local stage/federal agencies to identify San Juan River sampling logistics and schedules.
- Set up a subcontract agreement with the analytical chemistry laboratory.
- Communicate and coordinate with the subcontracted analytical chemistry laboratory to identify preferred analytical methods for the final list of target analytes.
- Prepare two draft Quality Assurance Project Plans (QAPPs), i.e., one for sample collection activities and one for sample preparation and analysis and submit them to the EPA Regional office for approval.
- Respond to agency review comments on the QAPPs and prepare a final sample collection activity QAPP and a final sample analysis QAPP
- Purchase supplies, prepare equipment, and mobilize staff for the sampling event.

NNEPA and Tt will work to finalize the study design and lay out a timeline for tasks and deliverables. Tt will communicate and coordinate with the NNEPA to finalize the logistical plan for sampling, confirm San Juan River sampling locations, and schedule the work with all

participating parties/agencies. Tt will coordinate with the NNEPA to prepare and secure approval of a Sample Collection Activities QAPP (prior to commencement of field activities) and an Analytical Activities QAPP (prior to commencement of laboratory analyses). Tt will set up a subcontract agreement with the analytical chemistry laboratory (to be determined) and coordinate with NNEPA and the laboratory to identify preferred analytical methods. During the mobilization phase, Tt will also purchase the supplies for field processing (i.e., fish sample wrapping and labeling) and shipment of the fish samples.

Estimated Phase 2 cost: $48,000

Phase 3 -- Implementation Phase

Implementation tasks include all activities associated with sample collection and distribution to the sample preparation laboratory:

- Provide Tt fisheries scientists to be on site during sampling events conducted by NNDFW and/or local state and federal agency personnel, to coordinate sample collection and/or pick-up, select target species/specimens, and pack and ship all samples.
- Collect fish from the six San Juan Study reaches:
  1) from Navajo Dam in NM to the to the Animas River confluence,
  2) from the Animas River confluence to Fruitland, NM,
  3) from Fruitland to the Mancos River confluence, NM,
  4) from the Mancos River confluence to the waterfall near Mexican Hat, UT,
  5) from the waterfall to Lake Powell, UT, and
  6) from Lake Powell proper.
- Attempt to collect, at a minimum, three composites (i.e., five fish each) of two to three species from each of the six sampling reaches focusing on fishes that are commonly consumed by humans. [Note: The final target number of samples and target species list will be resolved during the Design and Planning Phase.] NNDFW and/or local state and federal agencies will provide sampling equipment and personnel to collect fish from the study reaches, supported by Tt fisheries scientists.
- Wrap, label, and freeze all fish as whole specimens and ship all fish samples via priority overnight shipping service to Tt's Biological Research Facility in Baltimore, MD.

Implementation specifics will be detailed in the Sample Collection Activities QAPP (Volume 1 of 2). The Field Teams will attempt to collect at least three composites of five fish each from each of the six sampling reaches (following the recommendations and methods in USEPA 2000a and 2000b) focusing on fishes that are commonly consumed by humans. Every attempt will be made to collect the desired number and species of fish targeted for study, but the success of the sampling effort will ultimately depend on the natural diversity and abundance fish at each location. If the field teams encounter Razorback Suckers (*Xyrauchen texanus*) and/or Colorado Pikeminnows (*Ptychocheilus lucius*) during a sampling event, sampling operations will need to be halted at that location. If there are logistical or safety concerns that make a site inaccessible, sampling operations will also need to be shut down at that location. If the field teams are not successful in collecting the samples after a reasonable effort, NNEPA and Tt will immediately confer and decide on next steps, and the activities at the unproductive site will be documented.

Composite samples will be collected since they are cost-effective for estimating average tissue concentrations of target analytes and ensure adequate sample mass for analysis. A composite sample will consist of five individual fish, all of which will be large enough to provide sufficient tissue for analysis of the group of target analytes. Based on guidance in USEPA 2000a, fish used in a composite sample must meet the following criteria:

- all be of the same species,
- satisfy any legal requirements of harvestable size or weight, or at least be of consumable size if no legal harvest requirements are in effect,
- be of comparable size so that the smallest individual in a composite is no less than 75% of the total length of the largest individual,
- be collected at the same time (i.e., collected as close to the same time as possible but no more than 1 week apart) [Note: This assumes that a sampling crew was unable to collect all fish needed to prepare the composite sample on the same day. If organisms used in the same composite are collected on different days (no more than 1 week apart), individual fish will be frozen until all the fish to be included in the composite are available for delivery to the laboratory.], and
- be collected in sufficient numbers (five per composite) and of adequate size, i.e., adult specimens, that collectively will provide enough fillet biomass to allow analysis of recommended target analytes [to be determined during the Design and Planning Phase].

The field teams will include experienced fisheries biologists to ensure accurate taxonomic identification and prevent the mixing of closely related species. Individuals from different species must not be used in a composite sample due to notable differences in species-specific bioaccumulation potential. The Tt fisheries biologists will: coordinate sample collection with all participating parties; select target species/specimens; wrap, label, and freeze all fish as whole specimens; and ship them via priority overnight shipping service to the Tetra Tech Biological Research Facility in Baltimore, Maryland.

Inclusion of biomarkers (e.g., VTG) in the FY 2020 study will require additional effort, that is beyond fish collection, packaging, and freezing for contaminants analysis described above, including collection of fish blood samples and sex determination. VTG data collection will focus on a single species of fish (to be determined and based on availability) from the study area and an attempt to collect both male and female specimens from each study reach. Species/specimen availability in the study area will ultimately depend on river conditions at the time of collection and on the diversity/abundance of fish in each study reach.

Estimated Phase 3 cost: $200,000

Phase 4 -- Analysis

Analysis tasks include all activities associated with sample preparation and chemical analysis:

- Fillet, composite, homogenize, label, and freeze fish samples at Tt's Biological Research Facility.

- Ship frozen homogenates to the analytical chemistry laboratory via priority overnight shipping service.
- Store extra (archive) tissue at Tt's Biological Research Facility (for potential future analysis or eventual delivery to the NNEPA).
- Analyze each composite sample for target analytes.
- Prepare electronic analytical data deliverables.
- Conduct data validation of analytical results.

Upon receipt in Baltimore, Tt will implement the QC activities and procedures described in the approved Analytical Activities QAPP (Volume 2 of 2) to prepare (i.e., fillet and homogenize) samples for subsequent analysis including requisite inspection and verification of sample integrity, reconciliation of any sample condition or identification issues, as required, and procedural controls. To summarize, Tt will fillet, composite, homogenize, label, and freeze all composite fish samples at the Baltimore, MD Biological Research Facility. Aliquots of frozen tissue homogenates will be shipped to the analytical laboratory via a priority overnight shipping service. Tt will store extra (archive) tissue at the Biological Research Facility (for potential future analysis or eventual delivery to the NNEPA). The subcontracted analytical laboratory (to be determined) will analyze each composite sample for the following suite of analytes agreed upon during the FY 2019 Design and Planning Phase. Following analysis and upon receipt of the laboratory data package, Tt will conduct data validation of the analytical results, will verify completeness and compliance of the report relative to the requirements of the respective project QAPPs, and will forward the electronic analytical data deliverables to NNEPA.

Estimated Phase 4 cost: $150,000

Phase 5 -- Reporting

Reporting tasks include all activities associated with documenting sampling and analysis results:

- Prepare a technical report summarizing sampling activities and results, analytical results, fish tissue contaminant concentrations in relation to human health protection endpoints, and potential effects of EDCs as reflected by biomarker results.

Tt will prepare the technical report, including summarized sample results with comparisons to appropriate human health criteria. The report will also document any departures from the approved project plans, describe apparent limitations, and assess their impact on the usability of the data for the current project and future data users. Tt will prepare draft and final technical reports for NNEPA review that summarize sampling activities and results, analytical results, and fish tissue contaminant concentrations in relation to human health protection endpoints. The final deliverable will be a single, comprehensive study document.

Estimated Phase 5 cost: $70,000

Total Estimated Cost: $500,000

References

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